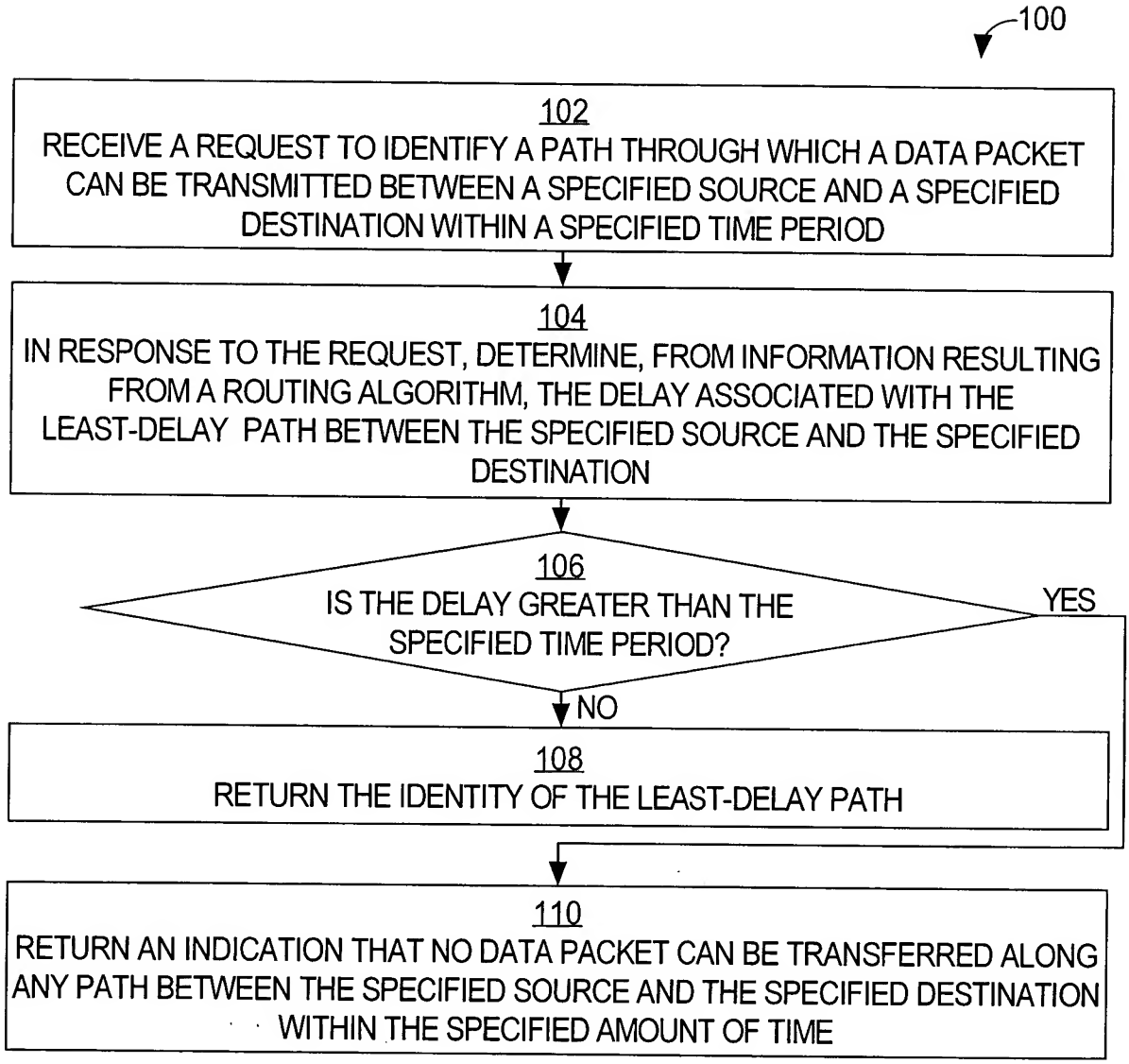

100
102
RECEIVE A REQUEST TO IDENTIFY A PATH THROUGH WHICH A DATA PACKET CAN BE TRANSMITTED BETWEEN A SPECIFIED SOURCE AND A SPECIFIED DESTINATION WITHIN A SPECIFIED TIME PERIOD
104
IN RESPONSE TO THE REQUEST, DETERMINE, FROM INFORMATION RESULTING FROM A ROUTING ALGORITHM, THE DELAY ASSOCIATED WITH THE LEAST-DELAY PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION
106
IS THE DELAY GREATER THAN THE SPECIFIED TIME PERIOD?
YES
NO
108
RETURN THE IDENTITY OF THE LEAST-DELAY PATH
110
RETURN AN INDICATION THAT NO DATA PACKET CAN BE TRANSFERRED ALONG ANY PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION WITHIN THE SPECIFIED AMOUNT OF TIME

FIG. 1

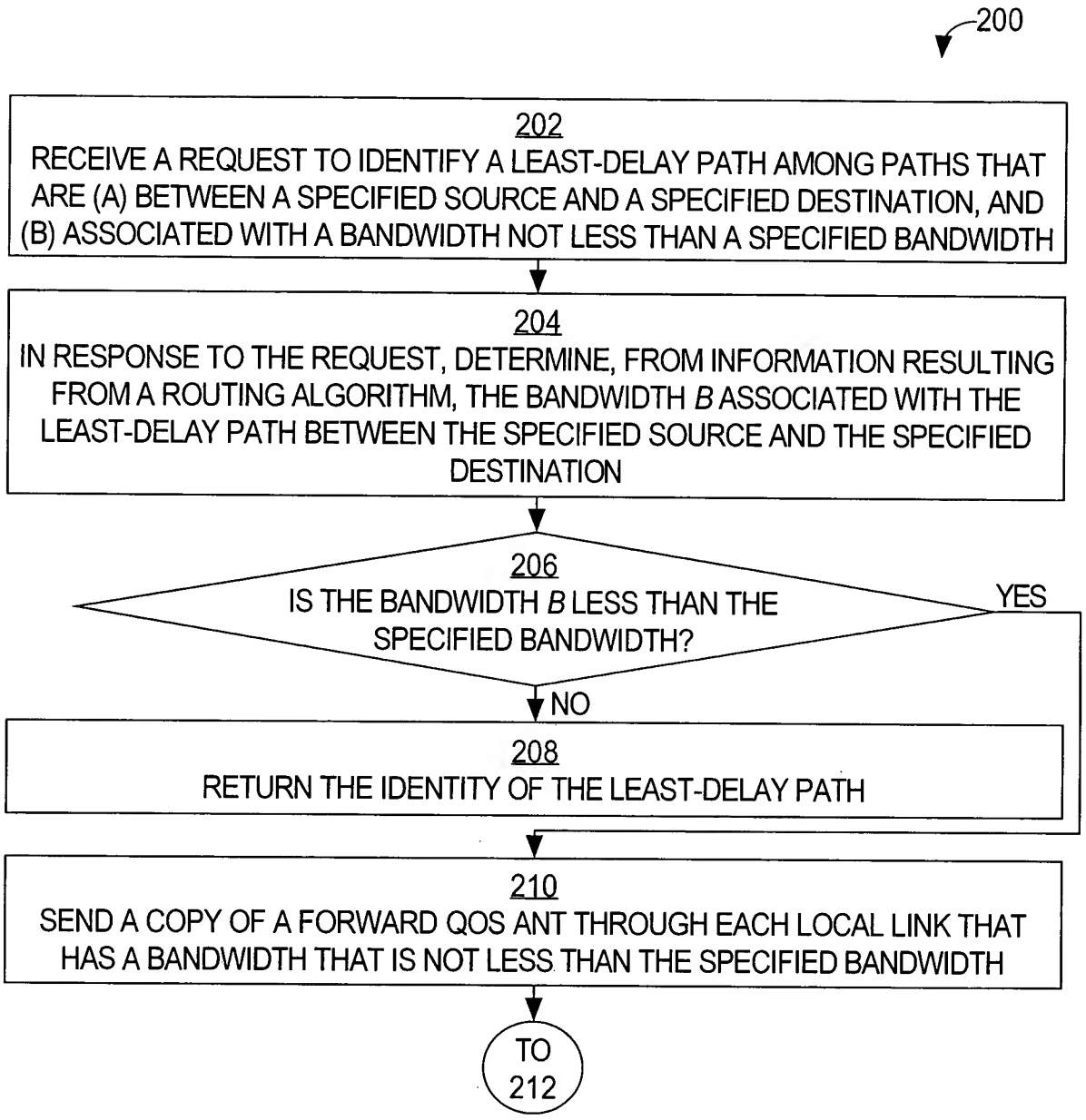

200
202
RECEIVE A REQUEST TO IDENTIFY A LEAST-DELAY PATH AMONG PATHS THAT ARE (A) BETWEEN A SPECIFIED SOURCE AND A SPECIFIED DESTINATION, AND (B) ASSOCIATED WITH A BANDWIDTH NOT LESS THAN A SPECIFIED BANDWIDTH
204
IN RESPONSE TO THE REQUEST, DETERMINE, FROM INFORMATION RESULTING FROM A ROUTING ALGORITHM, THE BANDWIDTH *B* ASSOCIATED WITH THE LEAST-DELAY PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION
206
IS THE BANDWIDTH *B* LESS THAN THE SPECIFIED BANDWIDTH?
YES
NO
208
RETURN THE IDENTITY OF THE LEAST-DELAY PATH
210
SEND A COPY OF A FORWARD QOS ANT THROUGH EACH LOCAL LINK THAT HAS A BANDWIDTH THAT IS NOT LESS THAN THE SPECIFIED BANDWIDTH
TO 212

FIG. 2A

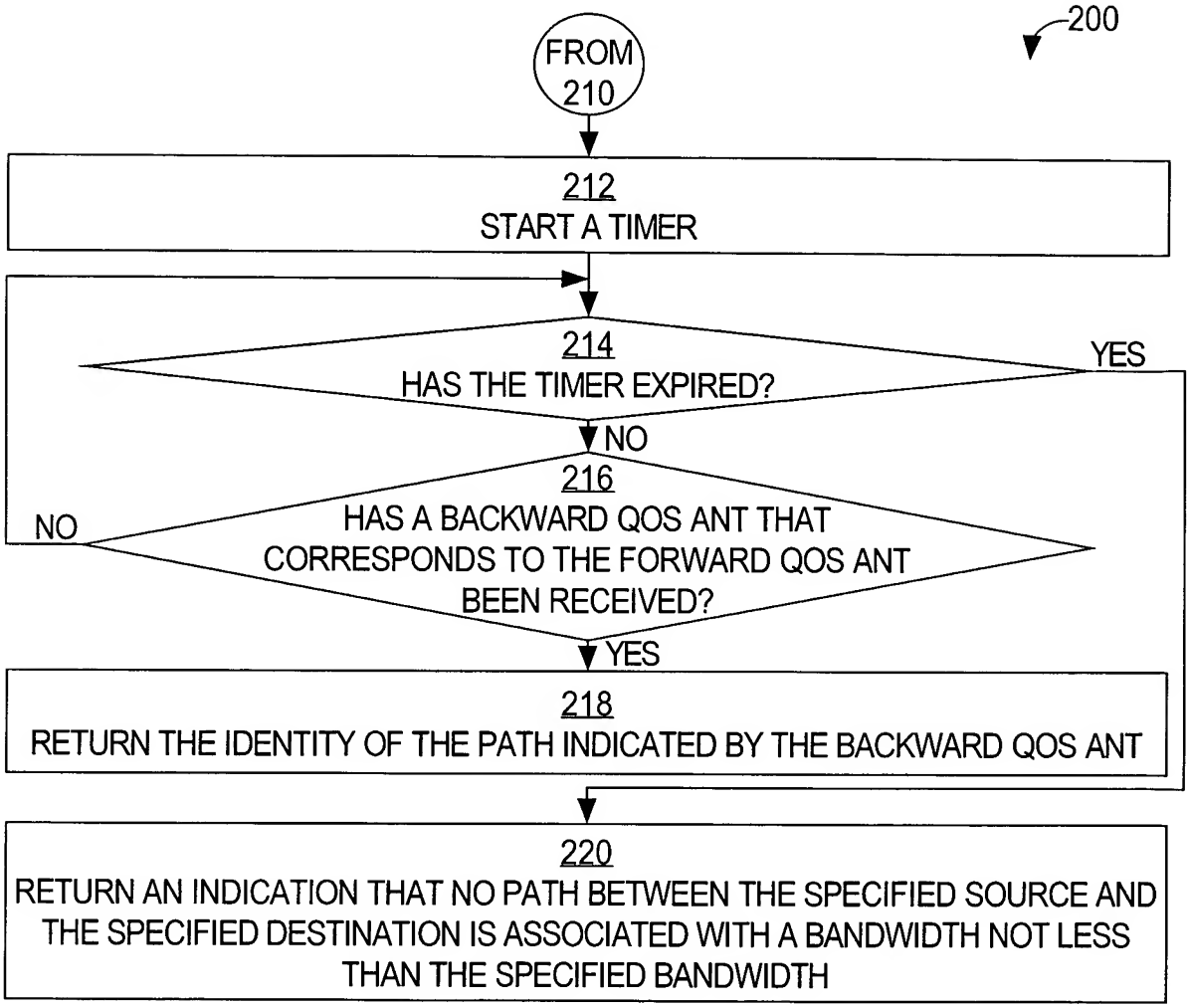

200
FROM 210
212
START A TIMER
214
HAS THE TIMER EXPIRED?
YES
NO
216
HAS A BACKWARD QOS ANT THAT CORRESPONDS TO THE FORWARD QOS ANT BEEN RECEIVED?
NO
YES
218
RETURN THE IDENTITY OF THE PATH INDICATED BY THE BACKWARD QOS ANT
220
RETURN AN INDICATION THAT NO PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION IS ASSOCIATED WITH A BANDWIDTH NOT LESS THAN THE SPECIFIED BANDWIDTH

FIG. 2B

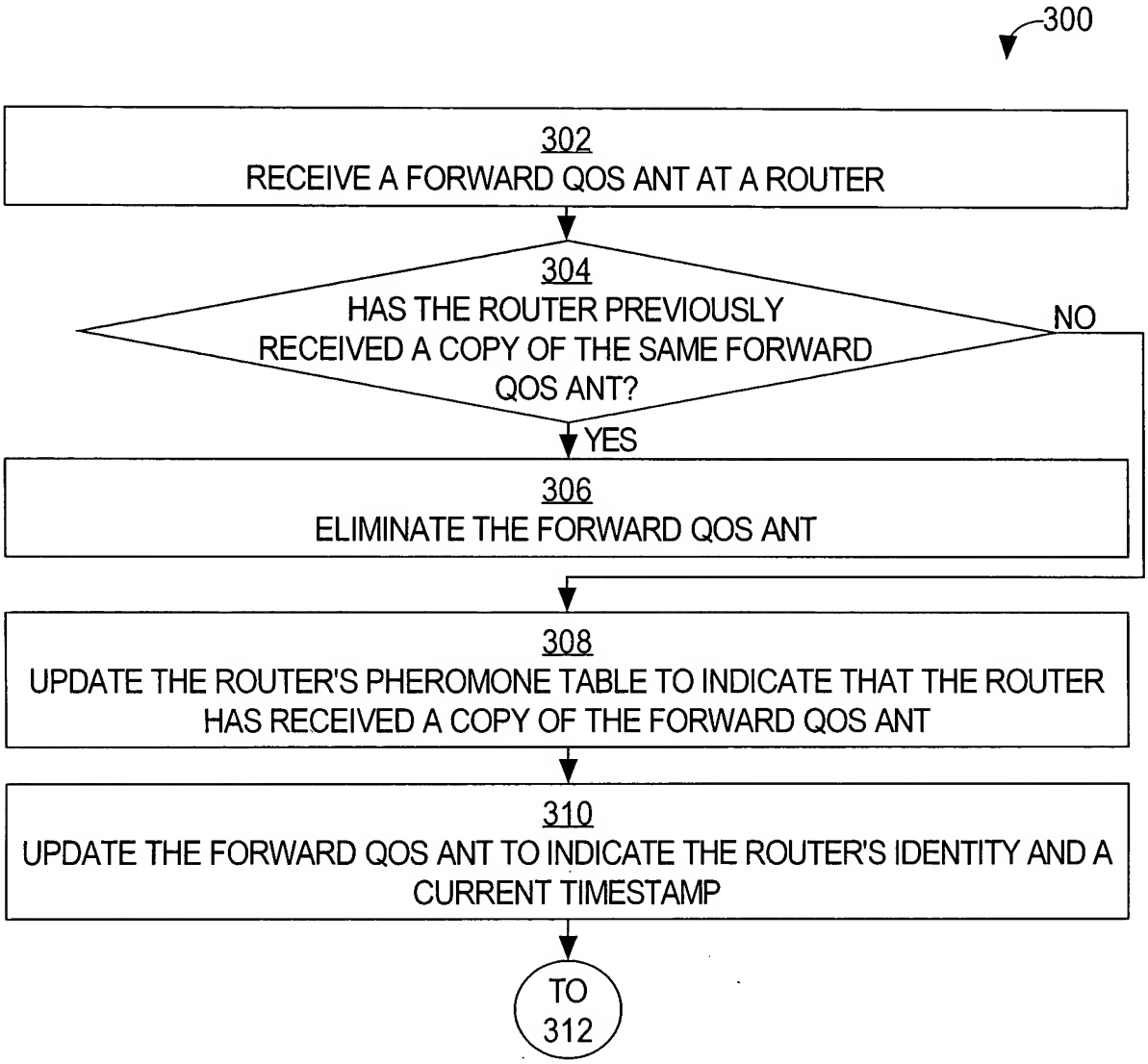
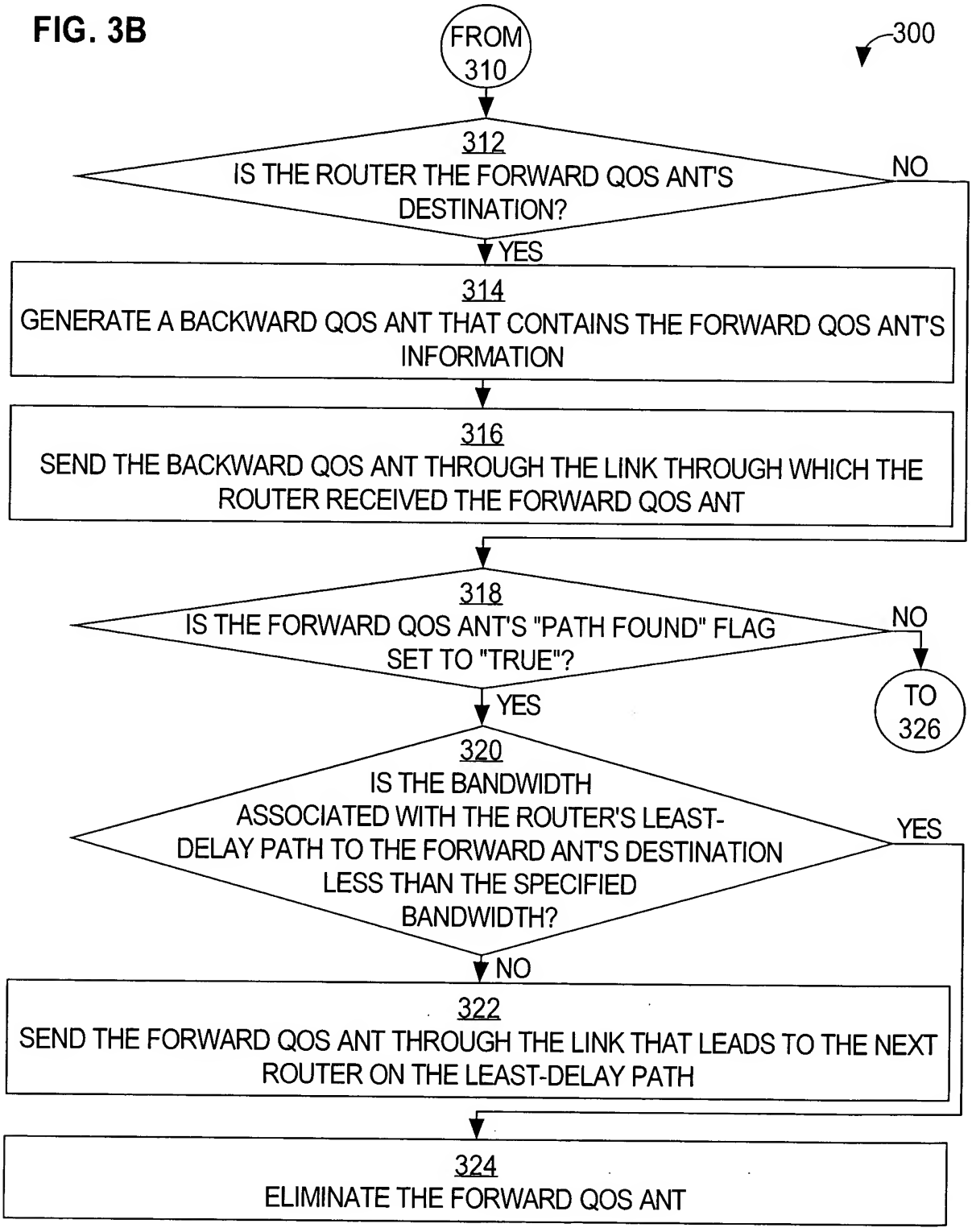

300
302
RECEIVE A FORWARD QOS ANT AT A ROUTER
304
HAS THE ROUTER PREVIOUSLY RECEIVED A COPY OF THE SAME FORWARD QOS ANT?
NO
YES
306
ELIMINATE THE FORWARD QOS ANT
308
UPDATE THE ROUTER'S PHEROMONE TABLE TO INDICATE THAT THE ROUTER HAS RECEIVED A COPY OF THE FORWARD QOS ANT
310
UPDATE THE FORWARD QOS ANT TO INDICATE THE ROUTER'S IDENTITY AND A CURRENT TIMESTAMP
TO 312

FIG. 3A

FIG. 3B


FROM 310
300
312
IS THE ROUTER THE FORWARD QOS ANT'S DESTINATION?
NO
YES
314
GENERATE A BACKWARD QOS ANT THAT CONTAINS THE FORWARD QOS ANT'S INFORMATION
316
SEND THE BACKWARD QOS ANT THROUGH THE LINK THROUGH WHICH THE ROUTER RECEIVED THE FORWARD QOS ANT
318
IS THE FORWARD QOS ANT'S "PATH FOUND" FLAG SET TO "TRUE"?
NO
TO 326
YES
320
IS THE BANDWIDTH ASSOCIATED WITH THE ROUTER'S LEAST-DELAY PATH TO THE FORWARD ANT'S DESTINATION LESS THAN THE SPECIFIED BANDWIDTH?
YES
NO
322
SEND THE FORWARD QOS ANT THROUGH THE LINK THAT LEADS TO THE NEXT ROUTER ON THE LEAST-DELAY PATH
324
ELIMINATE THE FORWARD QOS ANT

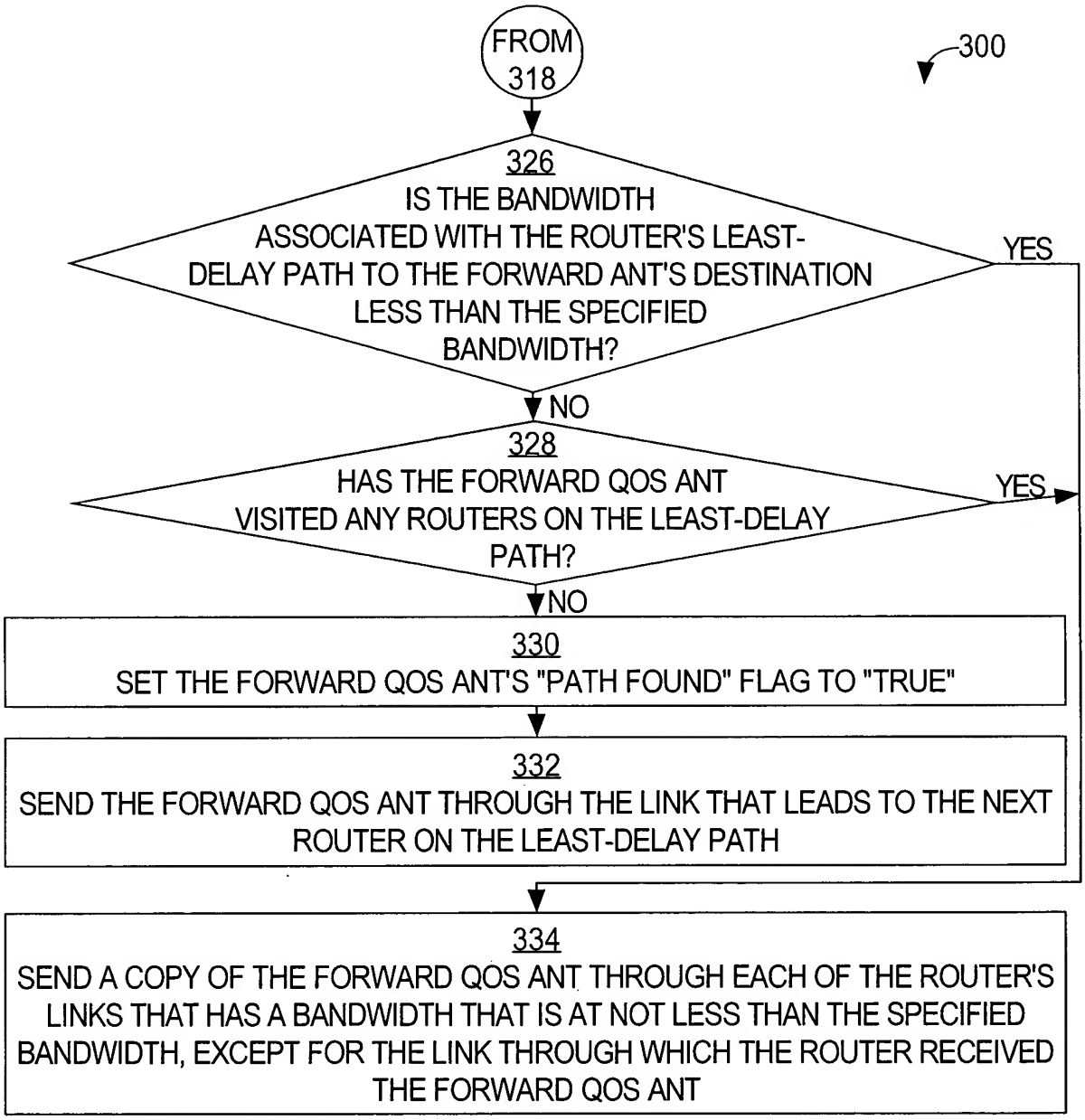

FROM 318
300
326
IS THE BANDWIDTH ASSOCIATED WITH THE ROUTER'S LEAST-DELAY PATH TO THE FORWARD ANT'S DESTINATION LESS THAN THE SPECIFIED BANDWIDTH?
YES
NO
328
HAS THE FORWARD QOS ANT VISITED ANY ROUTERS ON THE LEAST-DELAY PATH?
YES
NO
330
SET THE FORWARD QOS ANT'S "PATH FOUND" FLAG TO "TRUE"
332
SEND THE FORWARD QOS ANT THROUGH THE LINK THAT LEADS TO THE NEXT ROUTER ON THE LEAST-DELAY PATH
334
SEND A COPY OF THE FORWARD QOS ANT THROUGH EACH OF THE ROUTER'S LINKS THAT HAS A BANDWIDTH THAT IS AT NOT LESS THAN THE SPECIFIED BANDWIDTH, EXCEPT FOR THE LINK THROUGH WHICH THE ROUTER RECEIVED THE FORWARD QOS ANT

FIG. 3C

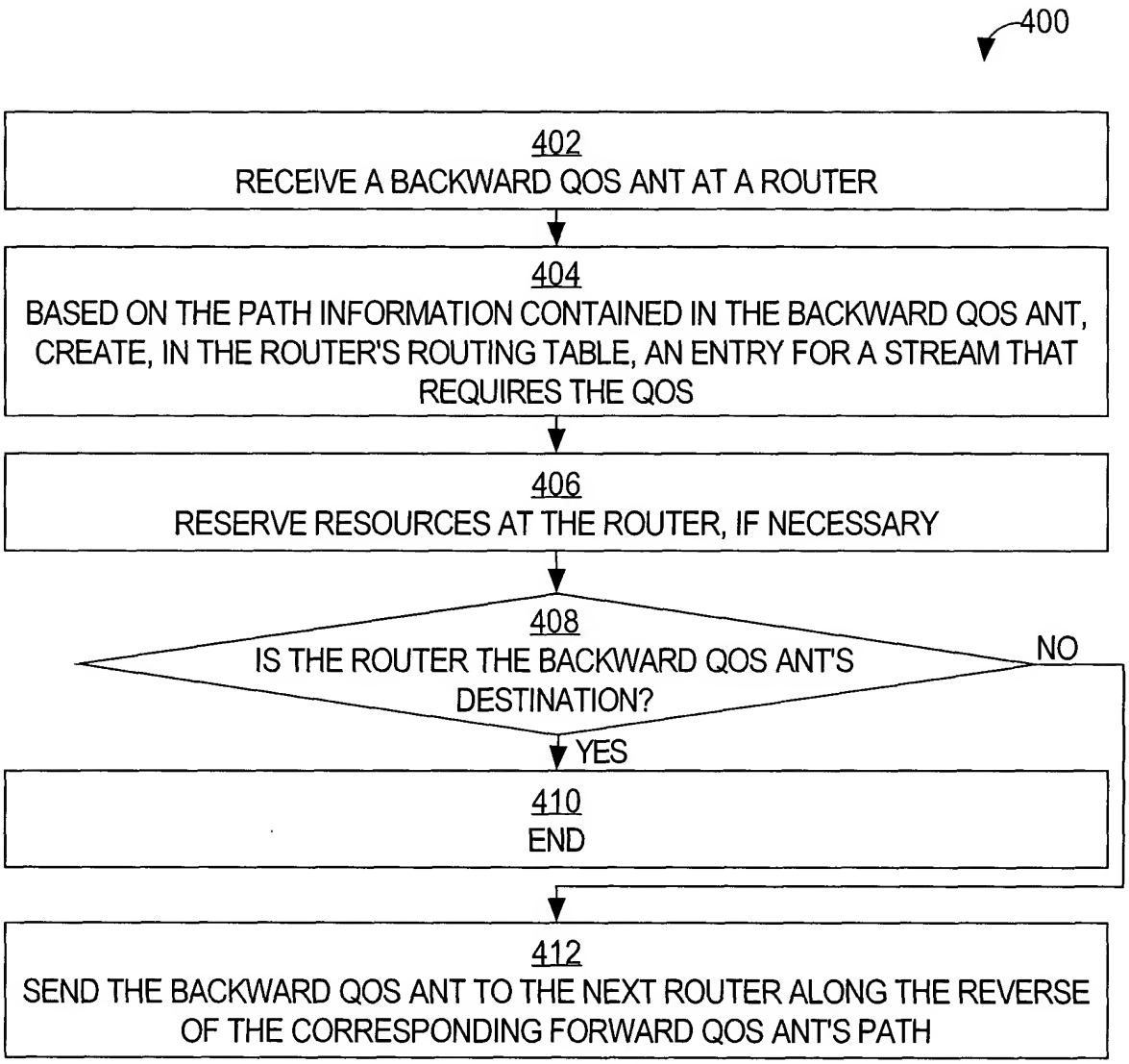

400
402
RECEIVE A BACKWARD QOS ANT AT A ROUTER
404
BASED ON THE PATH INFORMATION CONTAINED IN THE BACKWARD QOS ANT, CREATE, IN THE ROUTER'S ROUTING TABLE, AN ENTRY FOR A STREAM THAT REQUIRES THE QOS
406
RESERVE RESOURCES AT THE ROUTER, IF NECESSARY
408
IS THE ROUTER THE BACKWARD QOS ANT'S DESTINATION?
NO
YES
410
END
412
SEND THE BACKWARD QOS ANT TO THE NEXT ROUTER ALONG THE REVERSE OF THE CORRESPONDING FORWARD QOS ANT'S PATH

FIG. 4

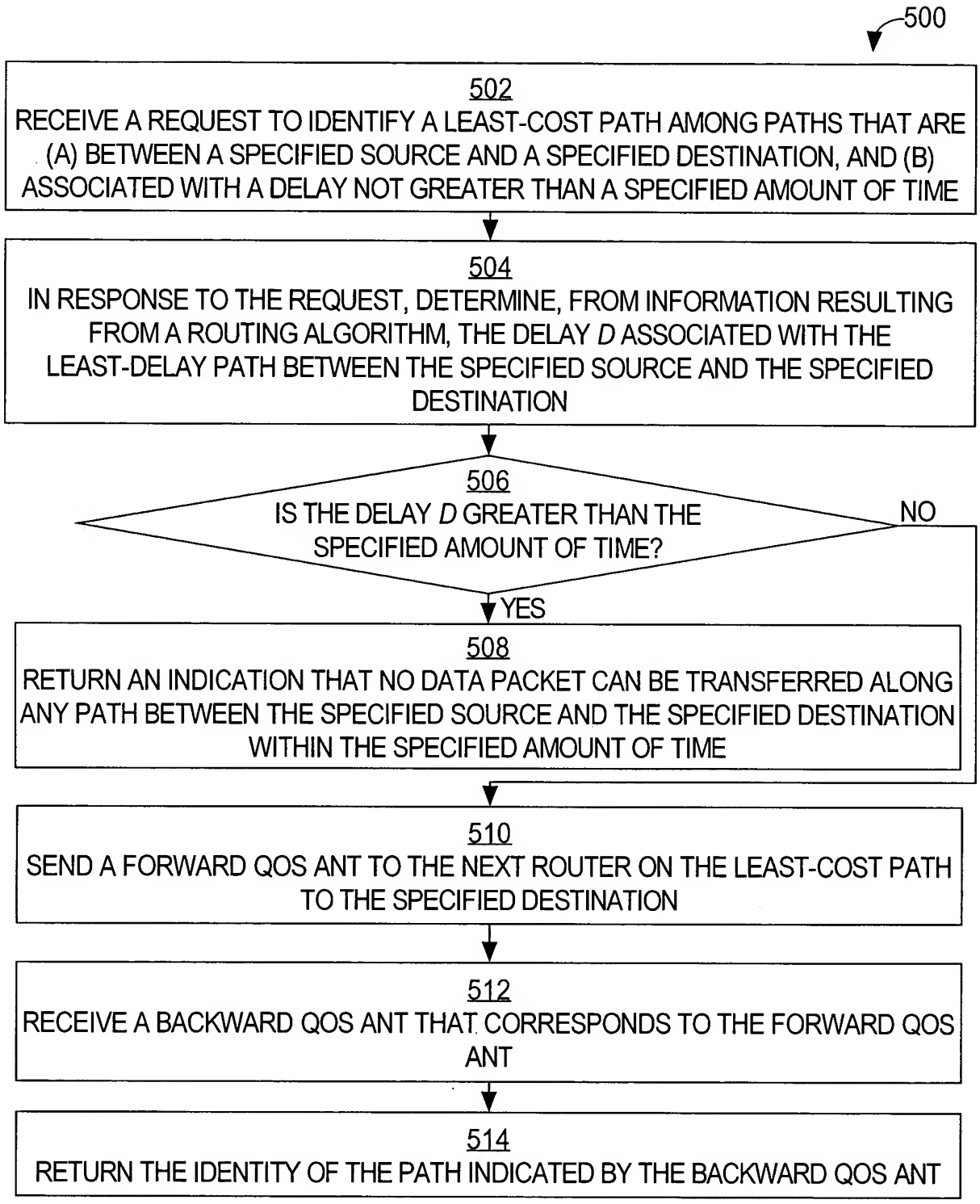
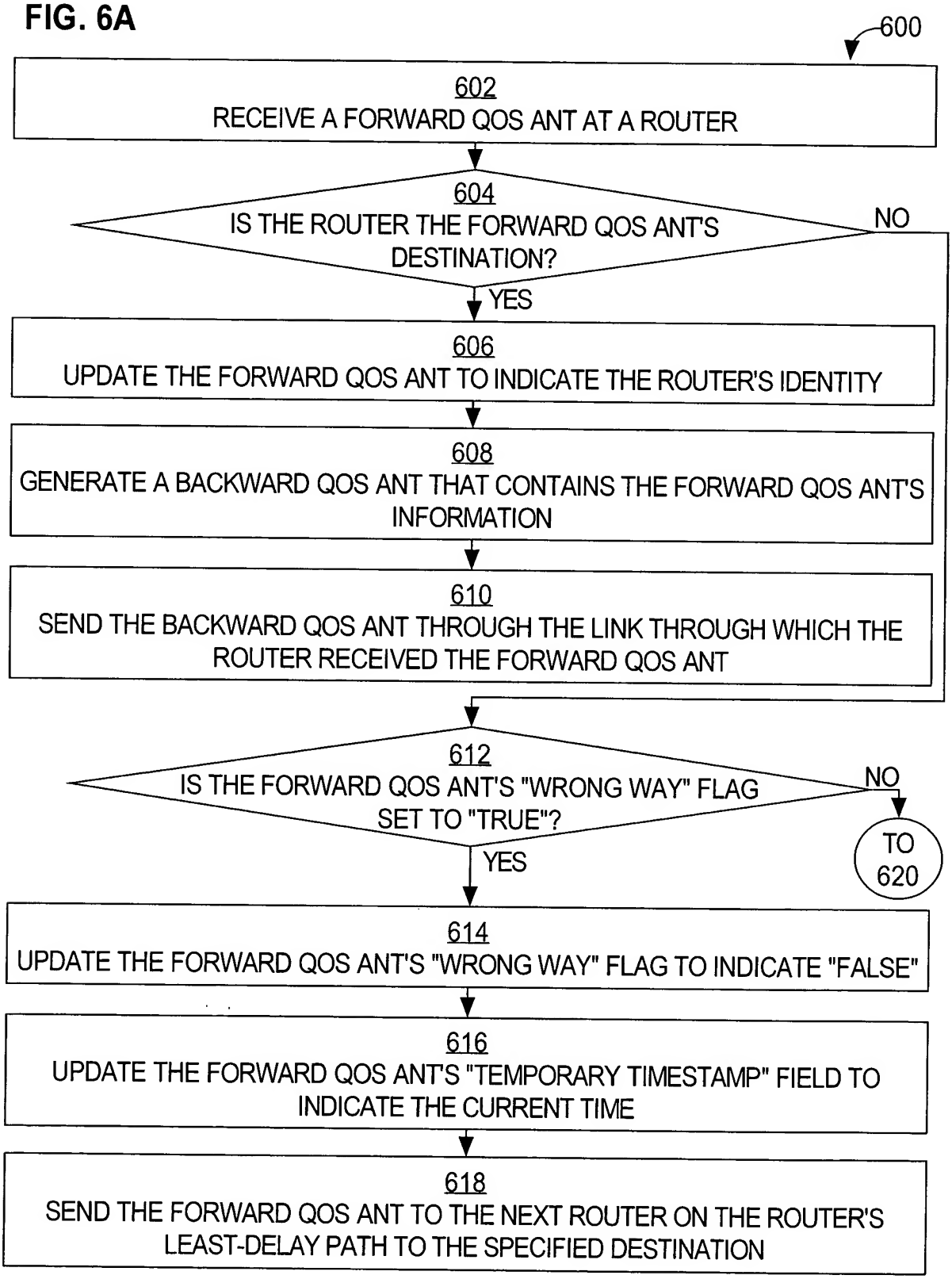

500
502
RECEIVE A REQUEST TO IDENTIFY A LEAST-COST PATH AMONG PATHS THAT ARE (A) BETWEEN A SPECIFIED SOURCE AND A SPECIFIED DESTINATION, AND (B) ASSOCIATED WITH A DELAY NOT GREATER THAN A SPECIFIED AMOUNT OF TIME
504
IN RESPONSE TO THE REQUEST, DETERMINE, FROM INFORMATION RESULTING FROM A ROUTING ALGORITHM, THE DELAY D ASSOCIATED WITH THE LEAST-DELAY PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION
506
IS THE DELAY D GREATER THAN THE SPECIFIED AMOUNT OF TIME?
NO
YES
508
RETURN AN INDICATION THAT NO DATA PACKET CAN BE TRANSFERRED ALONG ANY PATH BETWEEN THE SPECIFIED SOURCE AND THE SPECIFIED DESTINATION WITHIN THE SPECIFIED AMOUNT OF TIME
510
SEND A FORWARD QOS ANT TO THE NEXT ROUTER ON THE LEAST-COST PATH TO THE SPECIFIED DESTINATION
512
RECEIVE A BACKWARD QOS ANT THAT CORRESPONDS TO THE FORWARD QOS ANT
514
RETURN THE IDENTITY OF THE PATH INDICATED BY THE BACKWARD QOS ANT

FIG. 5

FIG. 6A


600
602
RECEIVE A FORWARD QOS ANT AT A ROUTER
604
IS THE ROUTER THE FORWARD QOS ANT'S DESTINATION?
NO
YES
606
UPDATE THE FORWARD QOS ANT TO INDICATE THE ROUTER'S IDENTITY
608
GENERATE A BACKWARD QOS ANT THAT CONTAINS THE FORWARD QOS ANT'S INFORMATION
610
SEND THE BACKWARD QOS ANT THROUGH THE LINK THROUGH WHICH THE ROUTER RECEIVED THE FORWARD QOS ANT
612
IS THE FORWARD QOS ANT'S "WRONG WAY" FLAG SET TO "TRUE"?
NO
TO 620
YES
614
UPDATE THE FORWARD QOS ANT'S "WRONG WAY" FLAG TO INDICATE "FALSE"
616
UPDATE THE FORWARD QOS ANT'S "TEMPORARY TIMESTAMP" FIELD TO INDICATE THE CURRENT TIME
618
SEND THE FORWARD QOS ANT TO THE NEXT ROUTER ON THE ROUTER'S LEAST-DELAY PATH TO THE SPECIFIED DESTINATION

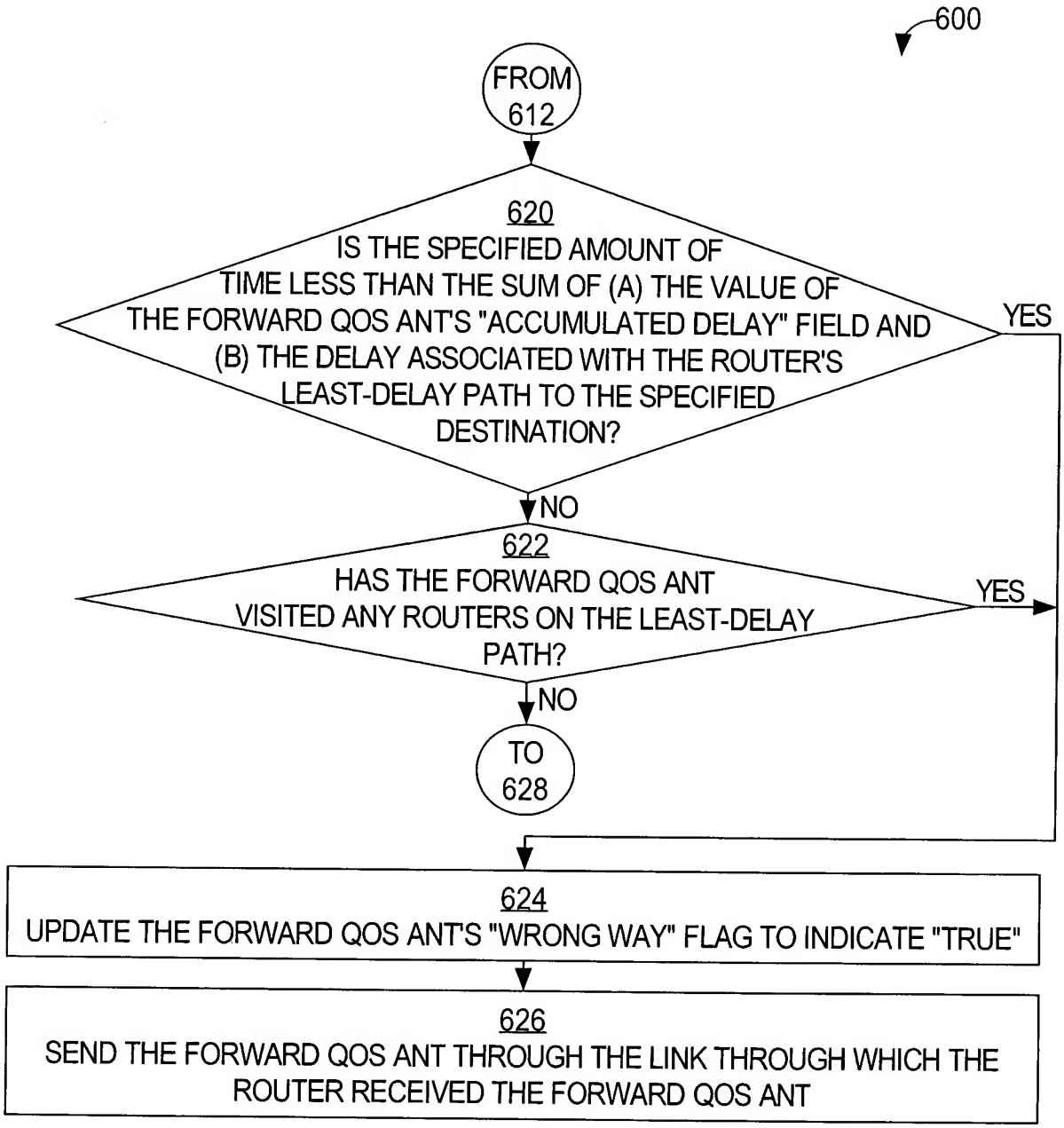

600
FROM 612
620
IS THE SPECIFIED AMOUNT OF TIME LESS THAN THE SUM OF (A) THE VALUE OF THE FORWARD QOS ANT'S "ACCUMULATED DELAY" FIELD AND (B) THE DELAY ASSOCIATED WITH THE ROUTER'S LEAST-DELAY PATH TO THE SPECIFIED DESTINATION?
YES
NO
622
HAS THE FORWARD QOS ANT VISITED ANY ROUTERS ON THE LEAST-DELAY PATH?
YES
NO
TO 628
624
UPDATE THE FORWARD QOS ANT'S "WRONG WAY" FLAG TO INDICATE "TRUE"
626
SEND THE FORWARD QOS ANT THROUGH THE LINK THROUGH WHICH THE ROUTER RECEIVED THE FORWARD QOS ANT

FIG. 6B

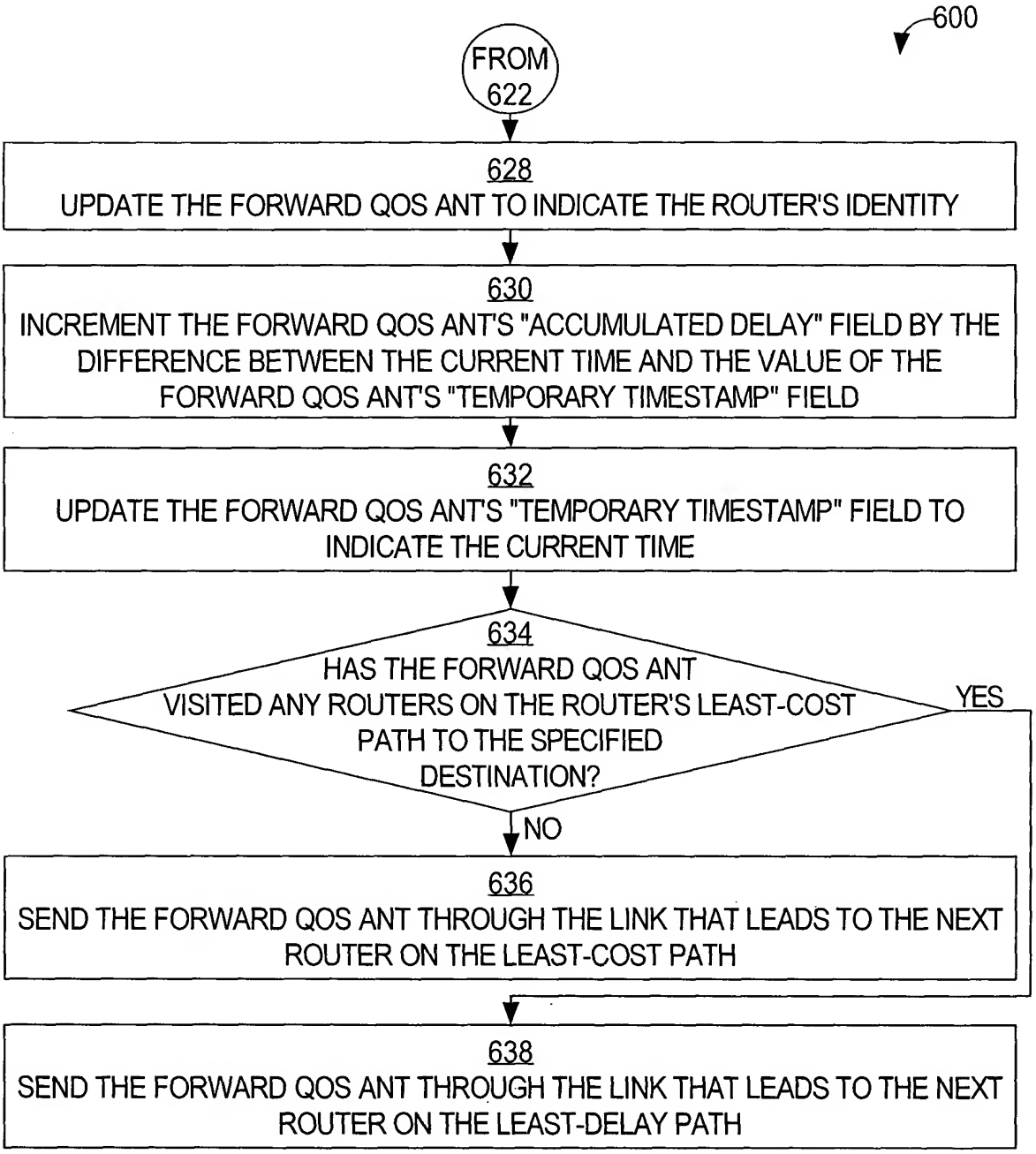

600
FROM 622
628
UPDATE THE FORWARD QOS ANT TO INDICATE THE ROUTER'S IDENTITY
630
INCREMENT THE FORWARD QOS ANT'S "ACCUMULATED DELAY" FIELD BY THE DIFFERENCE BETWEEN THE CURRENT TIME AND THE VALUE OF THE FORWARD QOS ANT'S "TEMPORARY TIMESTAMP" FIELD
632
UPDATE THE FORWARD QOS ANT'S "TEMPORARY TIMESTAMP" FIELD TO INDICATE THE CURRENT TIME
634
HAS THE FORWARD QOS ANT VISITED ANY ROUTERS ON THE ROUTER'S LEAST-COST PATH TO THE SPECIFIED DESTINATION?
YES
NO
636
SEND THE FORWARD QOS ANT THROUGH THE LINK THAT LEADS TO THE NEXT ROUTER ON THE LEAST-COST PATH
638
SEND THE FORWARD QOS ANT THROUGH THE LINK THAT LEADS TO THE NEXT ROUTER ON THE LEAST-DELAY PATH

FIG. 6C

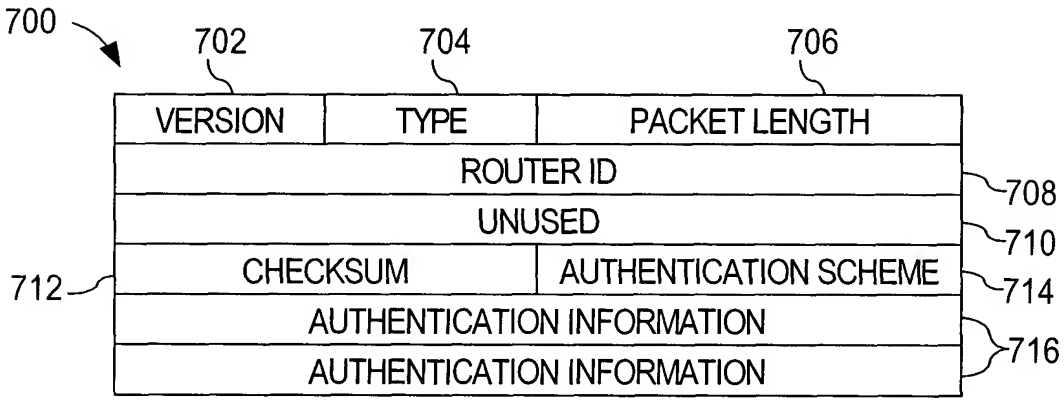
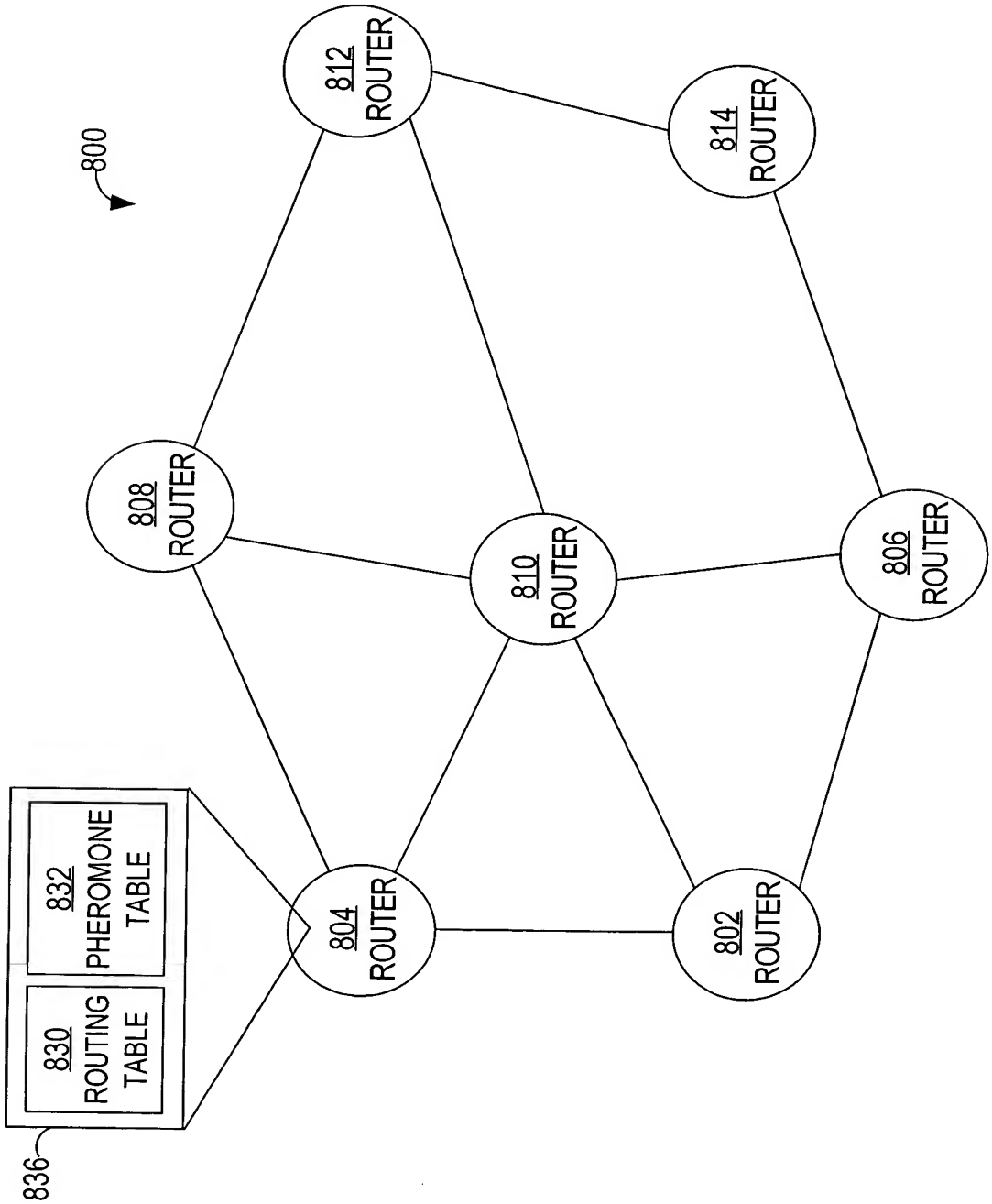

700
702
704
706
VERSION
TYPE
PACKET LENGTH
ROUTER ID
UNUSED
CHECKSUM
AUTHENTICATION SCHEME
AUTHENTICATION INFORMATION
AUTHENTICATION INFORMATION
708
710
712
714
716

FIG. 7

FIG. 8


800
812 ROUTER
814 ROUTER
808 ROUTER
810 ROUTER
806 ROUTER
804 ROUTER
802 ROUTER
832 PHEROMONE TABLE
830 ROUTING TABLE
836

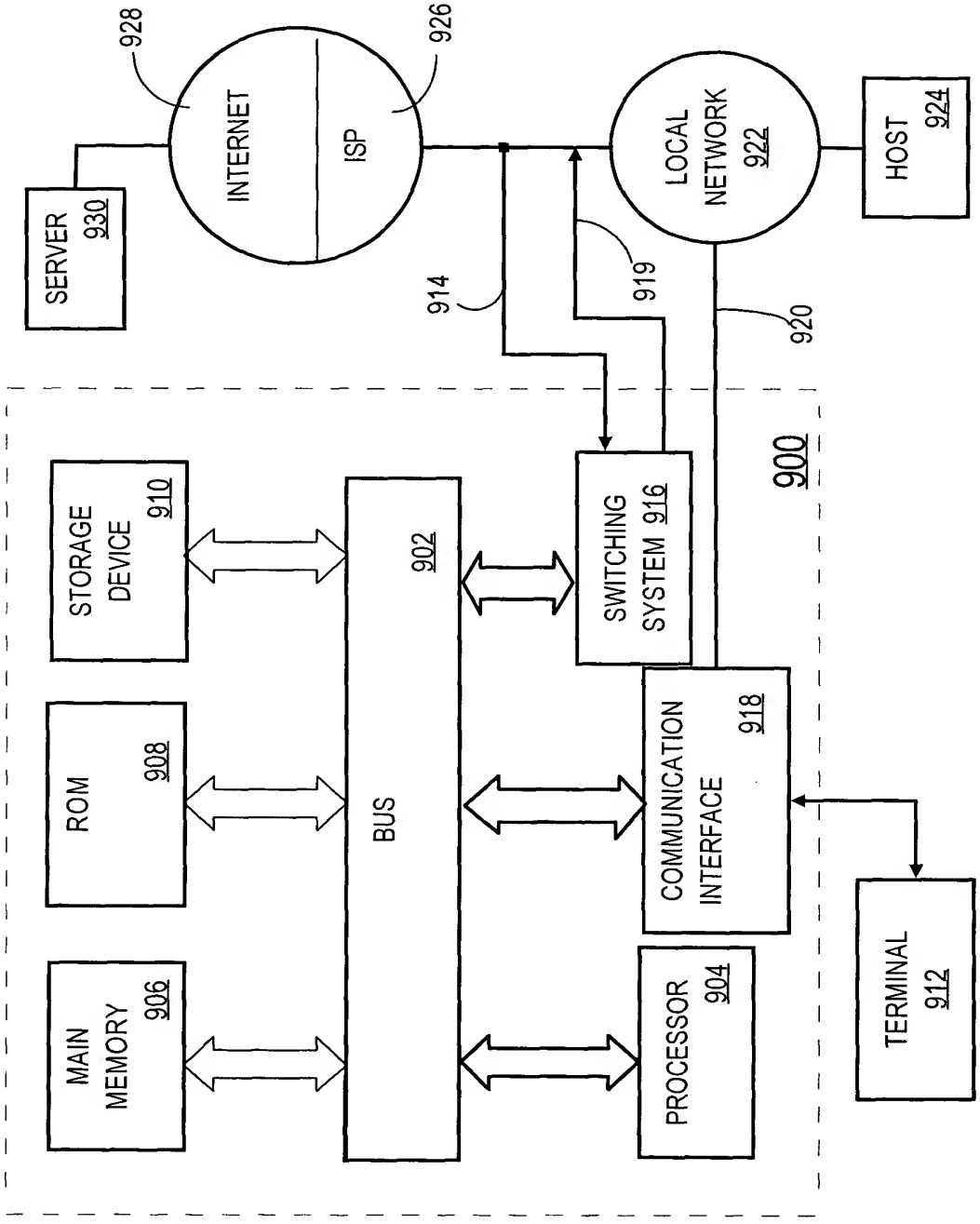

928
926
INTERNET
ISP
SERVER 930
LOCAL NETWORK 922
HOST 924
914
919
920
900
STORAGE DEVICE 910
ROM 908
MAIN MEMORY 906
BUS 902
SWITCHING SYSTEM 916
COMMUNICATION INTERFACE 918
PROCESSOR 904
TERMINAL 912

FIG. 9